

JAXA's Educational Activities through JEM Utilization

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Abstract

Japan Aerospace Exploration Agency (JAXA) has been committed to the educational activities using the Japanese Experiment Module (JEM/KIBO) on the International Space Station (ISS) for young generations, including Try-Zero G and Space Seeds programs for Japanese and Asian students. JAXA has also held the Students' Parabolic Flight Experiment programs for years, with successful accomplishment of the original objectives. In addition, JAXA has implemented the pilot projects and the studies on literal and social sciences using JEM, which we found have educational aspects. We are expecting to extend these results to the public for raising awareness and inspiring the next generations.

Keyword(s): Education, JEM, JEM Utilization

Received 18 September 2015, Accepted 30 March 2016, Published 30 April 2016

1. Introduction

Japan Aerospace Exploration Agency (JAXA) has been committed to the educational activities to inspire the next generation scientists, engineers and supporters for the aerospace projects and programs. Space Education Center at Sagami-hara is responsible for managing JAXA's overall educational activities, and each Directorate has been conducting the educational programs by means of its unique capabilities. JEM Utilization Center of Human Spaceflight Technology Directorate at Tsukuba has contributed to the educational activities using the resources on the Japanese Experiment Module (JEM) or KIBO of the International Space Station (ISS) and its expertise on human spaceflight.

JEM Utilization Center's concerns on its educational activities are to inspire the next generation users of JEM and the Low Earth Orbit (LEO), and to raise public awareness to the values of JEM, space environment utilization and human spaceflight. It has conducted multiple educational programs in orbit and on earth, and has utilized the products from these programs as the tools of educational and outreach activities. These programs are conducted within the framework of JEM Utilization named "Education Payload Observation (EPO)". The scope of EPO includes culture, humanities and social sciences, which is characteristic to JAXA's educational activities.

The products and the results of EPO programs are available on JAXA's HP¹⁾.

2. Highlights of EPO programs

2.1 Try Zero-G

Try Zero-G program has provided Japanese students with the opportunities to learn about space environment and basic

physical science through simple experiments inside JEM demonstrated by Japanese Astronauts.

In 2009, Astronaut Wakata performed the first Try Zero-G with 16 themes of physical science experiments selected out of 1,597 proposals from Japanese students. As one of these experiments, he demonstrated the Law of Action and Reaction, and the Law of Conservation of Momentum by using two balls floating inside JEM.

In 2010, Astronaut Noguchi performed 10 themes of physical science experiments as the second Try Zero-G, which included the experiments on the Principle of Rockets, and mixing of air and liquid.

In 2011, Astronaut Furukawa performed 11 themes of physical science experiments as the third Try Zero-G. He also performed the experiments named "Challenge Space Medicine", making use of his expertise as a medical doctor.

JAXA has been distributing the DVDs of Try Zero-G programs to the schools and museums in Japan so that they can use these videos as their educational tools.

As the next step of Try Zero-G, JAXA started to prepare for the Asia-Pacific version of Try Zero-G in 2012, by asking for proposals from the students of various Asia-Pacific countries through the framework of KIBO-ABC initiative of Asia-Pacific Regional Space Agency Forum (APRSAF).

In 2012, the first Try Zero-G 2 Asia was performed by Astronaut Hoshide with the physical science experiments proposed from Pakistan, Malaysia and Australia.

In 2014, Astronaut Wakata performed the second Try Zero-G 2 Asia, the experiments on the growing bubbles in water, Bernoulli's Principle, and mass and weight comparison.

For the next Try Zero-G 2 Asia, JAXA asked for the proposals in 2012 and 6 proposals were selected. Astronaut Yui

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will perform these experiments during his mission in 2015.

2.2 Space Seeds for Asian Future

Space Seeds for Asian Future (SSAF) is one of the educational programs of KIBO-ABC initiative, which is a sample return mission of plant seeds to and from JEM. The participants are provided with the opportunities to grow the plant seeds returned from JEM. More than one thousand students from Indonesia, Malaysia, Thailand and Vietnam participated in the first SSAF in 2010 and 2011.

The second SSAF was implemented in 2013 using AZUKI, popular beans in Asia. Astronaut Wakata supported the experiment in orbit. The students from Australia, Indonesia, Japan, Malaysia, New Zealand, Thailand and Vietnam conducted the experiments on earth and issued their reports on their results, which are available on JAXA's HP.

2.3 Space Poem Chain

Space Poem Chain or Uchu Renshi is a unique project to share the feelings and thoughts on space with participants through the poems succeeded from person to person.

In 2006, the Committee for Space Poem Chain started to compile the first edition. In 2007, it was completed with 24 poems, the first of which was contributed by Astronaut Yamazaki. In 2008, the DVD of the first edition was transported to and stored inside JEM by Astronaut Doi.

This program completed with the fourth edition in 2011. More than 3,000 people from all over the world participated in it through the proposals and contributions.

The book "Space Poem Chains" was published in 2008, and DVDs are also available.

2.4 Students Zero-Gravity Flight Experiment Contest

Before the EPO framework officially started, NASDA (one of the former bodies of JAXA) had started Students Zero-Gravity Flight Experiment Contest in 2002, using the surplus resources on the airplanes used for JAXA's parabolic flight experiments. This program aimed capacity building for the students of universities, graduate schools and colleges of technology to be the next generation users of JEM and LEO. The participants could learn the whole process similar to the on-orbit experiments and could learn the project management through proposal, planning, team working, development of devices, implementation of experiments, and reporting the results. This program also contributed to the capacity building for the other industry or business other than aerospace, including educators.

In 2013, 5 teams of students successfully completed the 11th Contest, and JAXA confirmed the original purposes of this program has been accomplished. JAXA decided to finish this program as a JAXA's initiative. Now the private sector, Diamond Air Services Inc. (DAS) and Japan Space Forum (JSF)

took over the role of the gateway for the parabolic flight experiments by students. JAXA will support the students upon their request with its know-how and expertise on microgravity and parabolic flight experiments.

JAXA had started Asian Students Parabolic Flight Contest in 2006, which aimed capacity building for the students of Asia-Pacific countries to be the next generation leaders of the aerospace field in this region.

This program also finished in 2013 with the accomplishment of its original purposes, and now some of Asian countries are willing to join JAXA's parabolic flight experiments at their own expenses through Kibo-ABC initiative.

The results of flight experiments by Japanese and Asian students are available on JAXA's HP²⁾.

2.5 EPO Pilot Mission

EPO Pilot Mission consists of the projects on the space art. The first-term 10 themes of arts in space were performed in 2010, followed by the second-term 7 themes in 2012.

PIs of these themes showed how the art in space can be, and confirmed the potentials of new art utilizing space environment.

In addition, we found the results of these projects can be used as the educational tools. The stories of preparation and implementation of these projects, as well as the products from them, can be used as the introductory lessons for young people to understand the space environment. JAXA has supported or participated in the events or symposiums on the space art as the educational and outreach activities.

2.6 Culture / Humanities and Social Sciences WG

Culture / Humanities and Social Sciences WG is one of the WGs of JEM Utilization Promotion Committee for JAXA, whose task was to suggest the scenarios for the researchers to study Philosophy, Arts and Behavioural Science in regard to human spaceflight. In 2015, the WG finalized the report on these scenarios and completed this task.

One of the unique products through the discussion on these scenarios is the book "Why we go to space - the values and meanings of space exploration from the viewpoint of Cosmo-Anthropology -" (provisional translation). It suggests another approach to think about relationship of space and human beings. Its philosophical approach, as well as the benefit approach, will be more important when we discuss the values and meanings of the next generation space exploration. We are going to use this book as the educational and outreach tool. This was published on August 6th, 2015.

3. Summary

JAXA will continue to conduct its educational programs making the most use of its resources on JEM / ISS, though the on-orbit programs like Try Zero-G and SSAF. JAXA also will continue to be engaged in the educational activities on earth by

making the most use of results and products from the past and future educational programs, and will continue to support the human spaceflight-related activities by students, educators, researchers, artists, curators and others with its know-hows and expertise.

In addition, JEM Utilization Center and Space Education Center are joining in the Education WG of ISS Program Science Forum, and sharing the information and discussing the possibilities of collaboration on the educational activities with the other ISS Partners.

Through these activities, we are going to maximize JEM Utilization on the educational activities, as well as the contributions to science and industries.

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